CLAIMS

What is claimed is:

1. A bipolar plate, comprising:

   a fluid barrier;

   a sealing frame formed around a perimeter of the fluid barrier, wherein the frame is formed by injecting a polymer into a mold overlapping the perimeter of the fluid barrier.

2. The bipolar plate of claim 1, wherein the fluid barrier is metal.

3. The bipolar plate of claim 1, wherein the fluid barrier is a material selected from titanium, stainless steel, nickel, tantalum, niobium, and alloys thereof.

4. The bipolar plate of claim 1, wherein the fluid barrier is plated with a metal.

5. The bipolar plate of claim 4, wherein the metal is selected from gold, silver, copper, platinum, and combinations thereof.

6. The bipolar plate of claim 1, further comprising:

   a first side of the fluid barrier having an anode flow field;

   a second side of the fluid barrier having a cathode flow field.

7. The bipolar plate of claim 6, wherein the anode flow field and the cathode flow field are attached to the fluid barrier before the sealing frame is formed around the perimeter.

8. The bipolar plate of claim 7, wherein the anode flow field and the cathode flow field are attached to the fluid barrier by methods selected from adhesives, sintering, soldering and combinations thereof.

9. The bipolar plate of claim 6, wherein the anode flow field and the cathode flow field are formed from a material selected from expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations thereof.

10. The bipolar plate of claim 6, wherein at least one of the anode flow field and the cathode flow field is chemically etched into the fluid barrier.

11. The bipolar plate of claim 1, further comprising:

a first gasket to provide a sealing surface between a first side of the sealing frame and a first membrane and electrode assembly;

a second gasket to provide a sealing surface between a second side of the sealing frame and a second membrane and electrode assembly.

12. The bipolar plate of claim 11, wherein the first and second gaskets are applied by print screening.

13. The bipolar plate of claim 11, wherein the first and second gaskets is incorporated into the sealing frame.

14. The bipolar plate of claim 1, further comprising components selected from alignment pins, alignment holes, reinforcing liners for fluid passages, fluid manifolds and combinations thereof, wherein the sealing frame is formed around the components.

15. The bipolar plate of claim 1, wherein the polymer is selected from a thermoplastic, a thermoset, a reactive set and combinations thereof.

16. The bipolar plate of claim 1, wherein the polymers are selected from polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof.

17. The bipolar plate of claim 16, wherein the selected polymer is mixed with a filler.

18. The bipolar plate of claim 17, wherein the filler modifies the performance of the polymer.

19. The bipolar plate of claim 17, wherein the filler is a diluent.

20. The bipolar plate of claim 17, wherein the filler is an aromatic polyamide fiber.

21. A bipolar plate, comprising:

a gas barrier having a cathode side and an anode side;

a cathode sealing frame adapted to receive a perimeter of the cathode side of the fluid barrier;

an anode sealing frame adapted to receive a perimeter of the anode side of the fluid barrier, wherein the cathode sealing frame and anode sealing frame are bonded together to form a fluid seal.

22. The bipolar plate of claim 21, wherein the fluid barrier is metal.

23. The bipolar plate of claim 21, wherein the fluid barrier is a material selected from titanium, stainless steel, nickel, tantalum, niobium, and alloys thereof.

24. The bipolar plate of claim 21, wherein the fluid barrier is plated with a metal.

25. The bipolar plate of claim 24, wherein the metal is selected from gold, silver, copper, platinum, and combinations thereof.

26. The bipolar plate of claim 1, further comprising:

the anode side of the fluid barrier having an anode flow field;

the cathode side of the fluid barrier having a cathode flow field.

27. The bipolar plate of claim 26, wherein the anode flow field and the cathode flow field are attached to the fluid barrier before the cathode sealing frame and the anode sealing frame are bonded together.

28. The bipolar plate of claim 27, wherein the anode flow field and the cathode flow field are attached to the fluid barrier by methods selected from adhesives, sintering, soldering and combinations thereof.

29. The bipolar plate of claim 26, wherein the anode flow field and the cathode flow field are formed from a material selected from expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations thereof.

30. The bipolar plate of claim 26, wherein at least one of the anode flow field and the cathode flow field is chemically etched into the fluid barrier.

31. The bipolar plate of claim 21, wherein a material used to form the sealing frames is a polymer.

32. The bipolar plate of claim 31, wherein the polymer is selected from a thermoplastic, a thermoset, a reactive set and combinations thereof.

33. The bipolar plate of claim 31, wherein the polymers are selected from polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof.

34. The bipolar plate of claim 33, wherein the selected polymer is mixed with a filler.

35. The bipolar plate of claim 34, wherein the filler modifies the performance of the polymer.

36. The bipolar plate of claim 34, wherein the filler is a diluent.

37. The bipolar plate of claim 34, wherein the filler is an aromatic polyamide fiber.

38. The bipolar plate of claim 21, wherein the sealing frames are produced by a method selected from injection molding, compression molding, machined, and combinations thereof.

39. The bipolar plate of claim 21, wherein the cathode sealing frame and the anode sealing frame are bonded by a method selected from heat welding, chemical welding, adhesives, and combinations thereof.

40. The bipolar plate of claim 21, further comprising:

a first gasket to provide a sealing surface between an anode side of the bipolar plate and a first membrane and electrode assembly;

a second gasket to provide a sealing surface between a cathode side of the bipolar plate and a second membrane and electrode assembly;

a third gasket to provide a sealing surface between the cathode sealing frame and the anode sealing frame.

41. The bipolar plate of claim 40, wherein at least one of the gaskets is an o-ring.

42. The bipolar plate of claim 40, wherein at least one of the gaskets is incorporated into one of the sealing frames.

43. The bipolar plate of claim 40, wherein at least one of the gaskets is applied by print screening.

44. The bipolar plate of claim 40, wherein the anode sealing plate and the cathode sealing plate further comprise components selected from alignment pins, alignment holes, reinforcing liners for fluid passages, fluid manifolds and combinations thereof.

45. The bipolar plate of claim 44, wherein the fluid barrier does not extend to the components.

46. The bipolar plate of claim 44, wherein the fluid barrier overlaps the anode sealing frame and the cathode sealing frame only a sufficient amount to create a fluid-tight seal.

47. A fluid cooled bipolar plate, comprising:

a cathode fluid barrier;

an anode fluid barrier;

an anode sealing frame adapted to receive a perimeter of an anode side of the anode fluid barrier;

a cathode sealing frame adapted to receive a perimeter of a cathode side of the cathode fluid barrier;

a cooling frame adapted to receive a perimeter of a cathode side of the anode fluid barrier and a perimeter of the anode side of the cathode fluid barrier, wherein an anode side of the cooling frame is bonded to the anode frame to form a fluid seal and the cathode side of the cooling frame is bonded to the cathode frame to form a fluid seal.

48. The bipolar plate of claim 47, wherein the fluid barriers are a material selected from titanium, stainless steel, nickel, tantalum, niobium, and alloys thereof.

49. The bipolar plate of claim 48, wherein the fluid barriers are plated with a metal.

50. The bipolar plate of claim 49, wherein the metal is selected from gold, silver, copper, platinum, and combinations thereof.

51. The bipolar plate of claim 47, wherein the cathode fluid barrier is of a different material than the anode fluid barrier.

52. The bipolar plate of claim 47, further comprising:

the anode side of the anode fluid barrier having an anode flow field;

the cathode side of the cathode fluid barrier having a cathode flow field;

a cooling flow field parallel to and between the cathode fluid barrier and the anode fluid barrier.

53. The bipolar plate of claim 52, wherein the anode flow field and the cathode flow field are attached to the fluid barriers before the cathode sealing frame and the anode sealing frame are bonded to the cooling frame.

54. The bipolar plate of claim 53, wherein the anode flow field and the cathode flow field are attached by methods selected from adhesives, sintering, soldering and combinations thereof.

55. The bipolar plate of claim 52, wherein the cooling flow field is attached to the cathode fluid barrier.

56. The bipolar plate of claim 55, wherein the cooling flow field is attached by methods selected from adhesives, sintering, soldering and combinations thereof.

57. The bipolar plate of claim 52, wherein the cooling flow field is attached to the anode fluid barrier.

58. The bipolar plate of claim 57, wherein the cooling flow field is attached by methods selected from adhesives, sintering, soldering and combinations thereof.

59. The bipolar plate of claim 47, wherein the anode flow field, the cathode flow field, and the cooling flow field are formed from a material selected from expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations thereof.

60. The bipolar plate of claim 47, wherein at least one of the anode flow field, the cathode flow field and the cooling flow field is chemically etched into at least one of the cathode fluid barrier and anode fluid barrier.

61. The bipolar plate of claim 47, wherein a material used to form the sealing frames is a polymer.

62. The bipolar plate of claim 61, wherein the polymer is selected from a thermoplastic, a thermoset, a reactive set and combinations thereof.

63. The bipolar plate of claim 61, wherein the polymers are selected from polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof.

64. The bipolar plate of claim 63, wherein the selected polymer is mixed with a filler.

65. The bipolar plate of claim 64, wherein the filler modifies the performance of the polymer.

66. The bipolar plate of claim 64, wherein the filler is a diluent.

67. The bipolar plate of claim 64, wherein the filler is an aromatic polyamide fiber.

68. The bipolar plate of claim 47, wherein the sealing frames are produced by a method selected from injection molding, compression molding, machined, and combinations thereof.

69. The bipolar plate of claim 21, wherein the cathode sealing frame, the anode sealing frame and the cooling frame are bonded by a method selected from heat welding, chemical welding, adhesives, and combinations thereof.

70. The bipolar plate of claim 47, further comprising:

a first gasket to provide a sealing surface between an anode side of the bipolar plate and a first membrane and electrode assembly;

a second gasket to provide a sealing surface between a cathode side of the bipolar plate and a second membrane and electrode assembly;

a third gasket to provide a sealing surface between the cathode sealing frame and the cooling frame; and

a fourth gasket to provide a sealing surface between the anode sealing frame and the cooling frame.

71. The bipolar plate of claim 70, wherein at least one of the gaskets is one or more o-rings.

72. The bipolar plate of claim 70, wherein at least one of the gaskets is incorporated into one of the sealing frames.

73. The bipolar plate of claim 70, wherein at least one of the gaskets is applied by print screening.

74. The bipolar plate of claim 47, wherein the anode sealing frame, the cathode sealing frame, and the cooling frame further comprise components selected from alignment pins, alignment holes, reinforcing liners for fluid passages, fluid manifolds and combinations thereof.

75. The bipolar plate of claim 74, wherein the anode fluid barrier and the cathode fluid barrier do not extend to the components.

76. The bipolar plate of claim 75, wherein the anode fluid barrier overlaps the anode sealing frame and the cathode fluid barrier overlaps the cathode sealing frame only a sufficient amount to create a fluid-tight seal.

77. A method for assembling the bipolar plate of claim 1, comprising:
providing a gas barrier;
providing a mold for forming a sealing frame;
inserting a perimeter of the gas barrier into the mold;
injecting a polymer into the mold.

78. The method of claim 77, further comprising:
bonding an anode flow field onto an anode side of the fluid barrier;
bonding a cathode flow field onto a cathode side of the fluid barrier.

79. The method of claim 77, further comprising:
etching an anode flow field onto an anode side of the fluid barrier;
etching a cathode flow field onto a cathode side of the fluid barrier.

80. The method of claim 77, wherein the polymer is selected from polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof.

81. A method for assembling the bipolar plate of claim 21, comprising:
providing a gas barrier;
providing a cathode sealing frame and an anode sealing frame;

adapting the cathode sealing frame and the anode sealing frame to receive a perimeter of the gas barrier;

aligning the cathode sealing frame and the anode sealing frame around the perimeter of the gas barrier;

bonding the cathode sealing frame to the anode sealing frame, wherein the bond creates a fluid tight seal.

82. The method of claim 81, further comprising:

bonding an anode flow field onto an anode side of the fluid barrier;

bonding a cathode flow field onto a cathode side of the fluid barrier.

83. The method of claim 81, further comprising:

etching an anode flow field onto an anode side of the fluid barrier;

etching a cathode flow field onto a cathode side of the fluid barrier.

84. The method of claim 81, wherein the anode sealing frame and the cathode sealing frame are made of a polymer.

85. The method of claim 84, wherein the polymer is selected from polyvinylidene fluoride, polyvinylidene difluoride, polytetrafluoroethylene, polyamides, polysulfone, polyetherketones, polycarbonate, polypropylene, polyimides, polyurethanes, epoxies, silicones, and combinations thereof.